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Bachelor Thesis

Improvement of Memorisation and Learning Through Visual Communication

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Abstract

Many students are having tough experiences with learning different subjects and materials in schools, universities and in many other educational institutions. This problem has many reasons, but one of the major concerns is the memorisation and understanding of the learning material. There are numerous scientific researches as well as philosophical theories on how human memory works. Many contradict each other but still the majority of them have much in common in terms of understanding the memorisation process as well as defining the influences that can affect it. This paper will explain, analyze and apply the literature and scientific researches about the memorisation process. The first part of the paper will briefly explain what memory is, how it works and how the human brain collects and retrieves the memorized information. Together with this common theories related to memorisation will be discussed, alongside with the role of emotions and their effects on the learning process. The second part of the paper will focus more on mnemonic techniques used by philosophers in the ancient Roman empire and explain their rhetoric teachings. The aim for this section is to show parallels to the moderately recent literature as well as to underline different approaches that exist in this field. The third part of this paper will define what effect different types of typography have on cognition and memory, and together with that will explain and analyze numerous studies and experiments conducted to define the differences and important aspects related to using different typographies. The last part of this paper will discuss the interview questionnaire that was provided to three eighth graders. The aim of this section is to justify previously mentioned theories, and to reference and stress the importance of the discussed topics. Overall there are many ways how the learning process, and specifically memorization process can be altered by external influences, and this paper will explain how these influences can be incorporated into the design of the school book. The overall goal of this paper is to create a history school book for eighth graders, which enhances the memorisation process by applying visual communication strategies.

1. Introduction

Memorisation is an essential cognitive process, shared by all human beings. It is involved in all other primary cognitive functions, such as perception, problem solving, reasoning and speech. Being such a vital part of human life, it is not a surprise that theorizing about the memorisation process dates way back to ancient societies. Understanding of memory has changed accordingly over time as it has transformed from something abstract and spiritual to something more physical and logical. Even though the nature of memory is still a mystery to the modern world, there are some solid discoveries on how it functions. Effectiveness of memorization can be measured by how well a person can revive the stored information. Thus when talking about education the measuring point of the success should be fast and correct revival.

2. Memory

In understanding the memory and about how it works, the best analogy to bring would be an accessible and portable library. Similar to memory, it has the capacity to actively store, organize and retrieve vast amounts of information, whenever there is a need. In the literature we can find three core functions of memory, which are defined as: ‘trace formation, trace storage and trace utilization’ which in easier terms can be translated to encoding, storage and retrieval (Melton, 1963). All three of these functions are essential stages for the formation of the memory, hence it is interesting to see what each of these core functions entail.

The first stage of the memorization process starts with encoding. Encoding is a process where the sensory information is converted into electrical impulses and chemicals by the human brain in order to make observed information understandable (Brown et al., 2014). According to Peter Brown this process of encoding can be done in one or multiple different ways: visually (according to somethings’ appearance), auditory (how something sounds), sematic (what something means), tactile (how something feels). As the information gets encoded, it is

being converted to pieces, which are called memory traces (Brown et al., 2014). The encoded information afterwards moves to storage.

As mentioned above, the second stage of the memorization process is called the storage. Again, let us return back to the analogy of the library. One of its main purposes is to categorize and store books in a structured manner, so that they are easily found and are available for anyone who searches for them. Similarly, the process that Peter Brown explains in the book describes how, where, how much and for how long will the encoded information be preserved in the memory. It is important to understand how the storage works, since it will give valuable insights for choosing the most efficient approach to make the memorisation process easier from the history book. According to cognitive research by Richard Atkinson and Richard Shiffrin, there are in total three different storage structures: sensory register, short term store/memory (STM) and long term store/memory (LTM). Each structure has a unique function, which is equally important for successful memorization (Atkinson & Shiffrin, 1968). This paper will provide in depth analysis of each function, workflow and the interconnectivity between these structures in later sections.

The third stage of the memorization process is the retrieval. Continuing with the analogy of the library, when someone wants to take out a book, they go to the library, find the right place where the book is stored, and take it to the checkout. Similarly in the retrieval stage an already stored information in the storage within the brain, can be accessed by human's and used accordingly. In this stage it can be observed if and how well the information was stored or to explain why it was forgotten.

All three memorisation stages mentioned above are very important to have a good understanding on how memory operates. Hence, the more granular understanding of this topic will be significant to guide and define the necessary frame where the visual instructional design should be applied. The next section will focus on the details on how the three different storage structures operate, and what effects they have on the retrieval process. Since the

interdependence and the process flow between these two memorisation stages define the effective memories and how they can be altered from the external environment.

2.1 Storage

As mentioned in the previous section, storage can be divided into the following three different structures: the sensory register, the short-term memory (or store) and the long-term memory (or store). The encoded information constantly flows through the aforementioned structures. The flow starts with the sensory register, and afterward moves to the short term memory. Depending on the efforts put in the memorisation, as a final step, the encoded information flows to the long-term memory (Atkinson & Shiffrin, 1968). *Image 1* below depicts the information processing model/ flow. The understanding of this flow, can help to define how this can be affected by external factors. This knowledge as a result can give valuable insights on how to ensure and trigger efficient learning for the students.

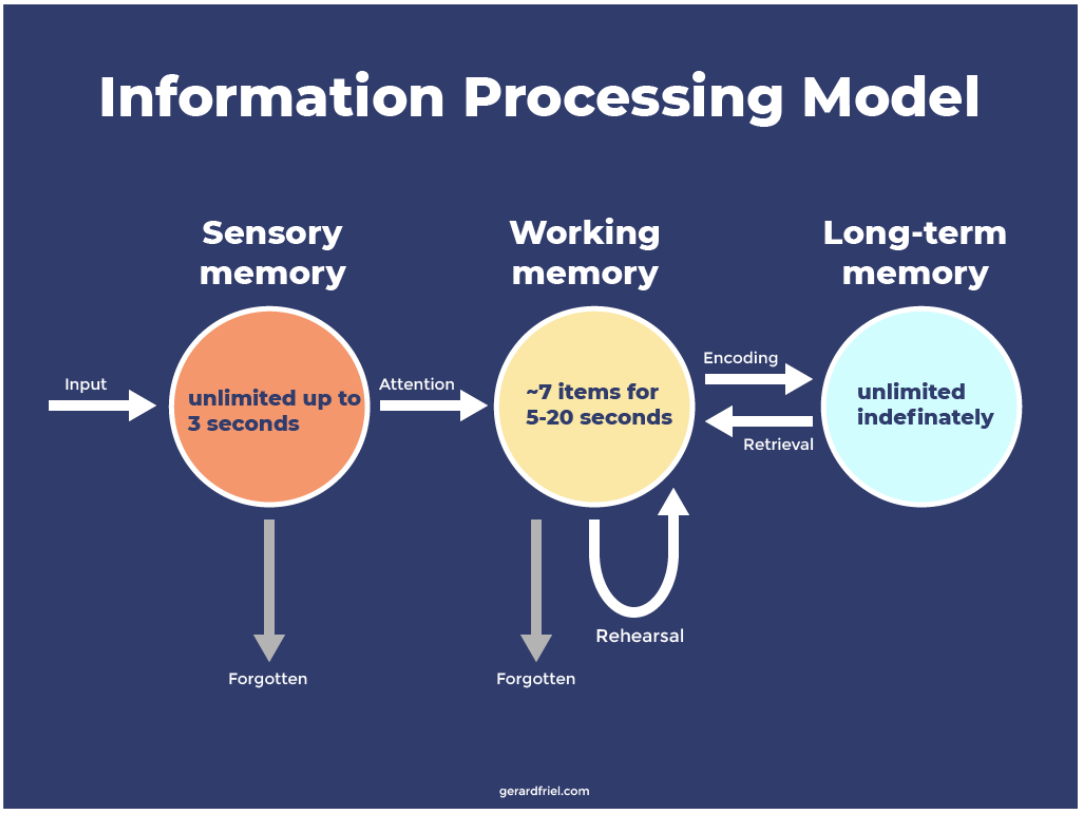

Image 1: (Friel, 2022)

When the sensory[1] information is encoded, it goes to a sensory register. This is a constant process of collecting information that the human brain does, so the sensory register has a large capacity to store if for a brief period of time. Lloyd and Margaret Peterson in their article on short-term retention of individual verbal items mention that information gets stored only for 0.2 to 0.5 seconds in the sensory registry (Peterson, 1959). The most important aspect for this process is the persons' attention, since it is what defines whether the encoded information will be moved to the short term memory or not (Dirksen, 2016). This aspect of how memory works is an important indication on how the learning material should be designed and compiled. Unless the student focuses his or her attention on the visuals, the textures, and the content of the text, all this sensory information will be removed from the sensory register in a short period of time. Based on this it can be deduced that the book layout should be an attention grabber, and all the distractions should be removed so the student can focus on a relevant topic or information to ensure that this information moves to the short term memory.

In comparison to the sensory registry, the short term memory which is also known as the working memory has less capacity for information storage but can store it for longer periods. As per the research the information can stay in the short term memory store for the duration of up to 30 seconds, and can hold approximately 7 (+/-2) pieces of information per try (Peterson, 1959). Also it is important to underline that if the sensory registry encodes all sensory information, the short term memory mostly encodes auditory information which is constantly rehearsed and refined for later transfer to the long term memory (Peterson, 1959). Similarly, information in short term memory can also be easily lost, especially when overloading the capacity. These insights about the memorisation process support the previous claim, that it is important to keep only concise, relevant and attention grabbing content in the learning material, to ensure their transfer to the long term memory.

Long term memory or shortly to abbreviate LTM, is the very last point of the information flow in the memorisation process. This memory store has unlimited storage capacity and can keep

[1] Connected with the physical senses of touch, smell, taste, hearing, and sight (Cambridge Dictionary)

this information for an unlimited time period. It is worth mentioning that the form in which information is stored in the LTM is called Schema. “Schemas allow elements of information to be categorized according to the manner in which they will be used” (Sweller, 2011). To give a specific example of what a schema is, one can look at a regular house. All objects or elements that can be connected to the house, such as the windows, doors, furniture, curtains etc. are gathered under the roof of one schema which in this case is the house itself. It is also possible to have sub categorization inside the schema, for example if the house is the main schema then the separate rooms would be its sub-categories, hence we can place the items in there e.g. windows, red curtains and couch can be subcategorized within the bedroom. Similarly the schemas stored in LTM can be accessed at any time and can be transferred back to short term memeory to further strengthen the memories for a later recall. Best practice of this would be elaborative rehearsals, where new pieces of information are being connected to already well remembered facts. For example when studying the lines for the play, relating the content of the lines to personal experiences can help to deepen the memory. Similarly if we apply this to history, previous experiences from movies, books, stories can be related to the new information gained from history lessons in school, which eases the whole memorisation process. In conclusion, it can be said that there are multiple aspects that can trigger and navigate the flow of newly read or seen information from the learning material in the three memory stores described in this section. There are numerous theories that describe how these triggers can be pulled, to ensure most efficient and productive memorisation of new content. The next chapter will explain further what approaches can be used and most importantly how they should be used based on these aspects.

2.2 Cognitive Load Theory

This section will discuss Cognitive load theory, proposed by John Sweller. In his writing he explains how cognitive architecture is built and what kinds of different cognitive loads can be created by the instructional information. There are three main types of cognitive loads: Intrinsic, Extraneous and Germane. Intrinsic and extraneous cognitive loads are always processed in working memory and are mostly imposed by learning materials, whereas germane cognitive load is not. It can be stated that germane cognitive load is more like a

working memory force which converts and stores the information (Sweller, 2011). This paper will discuss each of the loads separately and do an analysis on how they can be managed in visual terms.

2.2.1 Intrinsic and Extraneous Cognitive Loads

Intrinsic cognitive load is imposed from the basic structure and innate difficulty of the content, whereas extraneous deals with how the information is presented. Together they can account on how much cognitive load the material requires, in order to be learned. The heaviness of the load in both cases are measured by elements' interactivity. The interactive elements are the pieces of information that need to be processed simultaneously in order to acquire new knowledge. These exact elements are the parts of the schemas mentioned before in section 2.1. This can also be explained through the example. Imagine, learning one new word versus learning how to drive. Learning one new word is a very simple process since it contains only one element, but on the contrary learning to drive involves multiple complex elements that need to be processed simultaneously. Knowing the fact that the load occurs in working memory, which has low storage capacity, high interactivity of the elements can easily overwhelm the process resulting in poor or failed memory. Extraneous cognitive load also results from the high element interactivity, but in this case the presented elements are unnecessary and insufficient in relation to the learning content (Sweller, 2011). The simplest example for extraneous cognitive load can be found on many websites that display advertisements alongside the content. Advertisements have no logical connection to the presented materials and it distracts, and even in some cases overloads the working memory.

As previously mentioned germane cognitive load does not happen from learning the material itself, but rather it is the process where the knowledge acquisition happens. Germane cognitive load goes hand in hand with intrinsic cognitive load. In other words, the more element connectivity the learning material has, the more Germane work load is required. It is interesting to understand how Germane load operates, since what it does is to construct schemas from the given information, by linking the new elements to the old, already stored, schemas. In order to have better linking processes, a person must put a big amount of effort

into understanding and organizing given learning material. Looking at the fact it is safe to assume that the energy spent for germane cognitive load always pays off, by strengthening and securing memories in the long term store (Sweller, 2011).

In conclusion it can be said that different cognitive loads can be distracting and can hinder the learning process, but others on the contrary, are quite necessary to ensure long term memorisation, and easy understanding of the learning material. To emphasize the information mentioned in this section, one can deduct that managing intrinsic load can help to make information comprehensible. This can directly be translated to the school books, whereas extraneous cognitive load on the other hand should be decreased to its minimum, in order not to interfere with the learning process, and not to create distractions for the student. Germane cognitive load as the last point, should be encouraged since it can support students to easily acquire knowledge as well as to easily create the links to an already existing or familiar information. When thinking about reducing extraneous cognitive load in books, it is quite easy to imagine how it can be done. Simply by removing all unimportant information pieces and having a clear layout with a minimum amount of related text can reduce extraneous work load and also give specific order to the content. The potential implementation methodologies alongside mnemonic techniques will be discussed in detail in section 3.

2.3 Emotions and Memory

When discussing factors that influence the memorization process or in general the learning process, it is important to mention the emotions. It is common knowledge that students experience various emotions while studying, when sitting in the classroom or taking tests. Emotions differ by nature; they can be negative or positive and vary in intensity. When most of the emotions are generated through personal life events, a lot of them can reside in the academic settings. According to R. Pekrun, there are several classifications of emotions: 1) Achievement emotions which arise from the success or failure of the conducted activity; 2) Epistemic emotions which are triggered by cognitive problems and most commonly relate to surprise, curiosity, confusion or frustrations; 3) Topic Emotions, which occur directly while interaction with presented study materials (e.g. an empathetic attitude towards the protagonist

of a novel; excitement when discussing an art piece); 4) Last example is the Social emotions. This type of emotion is linked to the relationship between pairs or teachers, and can evoke love, sympathy, compassion, admiration, etc. Studies have shown that all emotions that are listed above can affect students' effectiveness in learning (Pekrun, 2014). As a continuation on this topic, the next section of this paper will discuss how these emotions impact the learning process and how design can assist with evoking positive and study-effective feelings. This will be a significant component for the creation of the actual design framework for the final project.

2.3.1 Positive Emotions in Learning

Moving on, positive emotions are related to pleasant experiences, and in psychology this type of emotional activation is called the arousal. Positive emotions can be experienced in two different ways: activating or deactivating (Pekrun, 2014). Activation emotions are enjoyment, excitement, hope or pride, while deactivating emotions are relief and relaxation. These types of emotions can influence students' "attention, motivation, use of learning strategies and self-regulation of learning" (Pekrun, 2014). As mentioned before, attention is the key aspect, when one is talking about an efficient learning process. It is a fact that correct positive emotion can play a huge role in strengthening the attention and letting students completely submerge in a presented task. Hence, these emotions can also be disadvantageous. It is important to note that they can also be completely disruptive for the students when learning new material. All the positive emotions that do not relate to the task can reduce efficiency of learning (Pekrun, 2014). For example students may get distracted and excited by fantasizing about their future achievements or their grades during the studying process, in which case they would pay less attention to the task and as a result fail to fulfill or to learn. Motivation and interest is also one of the things that can be evoked when experiencing joyful and exciting emotions. In most cases the student experiences joy when the task at hand is interesting, understandable and easily learnable. The feeling of competence intrinsically (motivation that is based on interest) motivates students to study further and better (Pekrun, 2014). Even in this case emotions can be misleading, since if deactivating positive emotions such as relaxation and relief is experienced, the student may lose the motivation. So there

always should be something that would interest the students and that would push them to get out of their comfort zone (Pekrun, 2014).

Returning back to the beneficial impact of positive emotions, one can also discover new and more efficient learning strategies for the various topics. If a student is genuinely interested in a task he or she has a more relaxed and open minded approach to the learning. It is easier for them to elaborate on, organize and analyze the content, which results in more productive learning. Positive emotions can also promote self-regulation during learning. When the self competence in relation to the matter grows, students will have more motivation to self discipline and learn (Pekrun, 2014). Similarly when discussing the framework for the design of the school book or an application, it is interesting to consider how the actual design can evoke positive and task related emotions, to grab students' attention and to motivate when learning new materials.

2.3.2 Negative Emotions and Learning

Similarly to positive emotions, negative emotions also affect attention, motivation, use of learning strategies and self regulation of learning (Pekrun, 2014). The negative emotions such as anxiety, anger and shame are activating emotions, whereas helplessness and boredom are deactivating emotions. In contrast to positive emotions, negative ones draw students' attention away from the learning (Pekrun, 2014). For example if the student has anxiety, he or she might spend all the time worrying about the failure, which will very negatively impact the actual learning. In the same manner, boredom causes attention to drift and go into daydreaming, a very common experience when a student falls asleep during a lesson or even while studying. In terms of motivation negative emotional effects can go in two ways. One way is when because of the anxiety and the shame intrinsic motivation and interest are decreasing resulting in avoidance of studying and most probably in failure (Pekrun, 2014). Opposing this, the second way of negative emotions can motivate a student if he or she has external pressure to overcome an obstacle (Pekrun, 2014). Even though the motivation can also arise from the negative emotions, like anxiety or shame, it does not have the healthiest

effects on students and the learning process. Learning strategies also do not develop when negative emotions take over, since such a situation mostly leads to rehearsals and rote memorization, which in most cases is time consuming and has a smaller effect on efficient memorization (Pekrun, 2014). Adding to this, negative emotions reduce innate flexibility and creativity and as a result undermine self-regulation. Therefore students who have learning anxiety mostly rely on using shortcuts for studying like: cheating or asking help from external sources.

To consider that emotions play a big role on students' motivation and interest in learning, it is important to define how the books themself can reinforce positive emotions as well as to eliminate or minimize negative emotions. The design should ensure and support the fact that students should learn the material in their own creative way. Feeling of the accomplishment as well as other aspects of the positive emotions will spike their attention as well as increase the interest to learn more. This can lead so to say, to a self reinforcing loop, where the student acknowledges and sees his or her achievements, and realizes that learning is not a burden, or something that is out of reach. This is why when discussing the design and the outline of the learning books, it is important to consider the emotional, biological and scientific aspects in order to ensure the most efficient as well as interesting and novel framework for such education.

2.4 Social Cognitive Theory

Emotions as discussed play an essential role in the learning process. It is interesting to see how different theories and methodologies add up together and support the same ideas and logic, though from different perspectives. To draw a parallel to negative and positive emotions, the paper will explain the social cognitive theory based by Albert Bandura, a Canadian-born American psychologist. He is best known for his Bobo Doll experiment, which demonstrated that children form certain behaviors based on the observations (Nolen, 2021). In this section it will be discussed how Albert Bandura explains two different kinds of motivations, 'Intrinsic and Extrinsic', and as a result shows what different emotions have in

common with the two types of different motivations. As a result valuable findings will be obtained that will be used for defining further specifics of the history books' design.

Many different thoughts exist about where the motivation comes from. Some believe that motivation for learning should come innately from personal interests, whereas others think the motivation is coming from external sources like a social recognition or higher status. The same applies when talking about learning motivation. It is quite logical to say that when a student learns new material, he or she might lack the competence, therefore the task at hand seems tiresome and uninteresting. It is until students acquire competence that the task becomes rewarding, and drives motivation (Bandura, 1977). For example when a child is learning to read or write, or when studying a language, at first the task is very frustrating since it is difficult, new and unfamiliar, but after the student gets proficient and when he or she starts to master the skill of reading, the practice becomes enjoyable and interesting. The aim for a parent or a teacher in this scenario is to encourage students to proceed with learning until their skills are strengthened. Albert Bandura discussed two different types of motivation in his work, which he mentions as intrinsic and extrinsic motivation. Intrinsic motivation is when a person does specific activity only for inherent satisfaction and joy, whereas extrinsic motivation is when a person is promised awards from external sources (Bandura, 1977). Example of this can be a child who is playing the piano. The main idea of playing the piano is to be satisfied and excited from the playing itself, so when a child has such feelings towards playing, this can be considered as intrinsic motivation. In contrast to this, when comparing a case where a child is forced to attend the piano lessons with the only purpose of satisfying a parent or to get an appraisal from a teacher, Albert Bandura refers to this as an extrinsic motivation (Bandura, 1977). Both motivations can help the students to a certain extent to improve and learn, but it is interesting to understand which type of motivation can have better and healthier effects on learning during the practice. Based on the previous section, it can be said that intrinsic motivation is mostly associated with positive emotions that aid the learning experience, and extrinsic load is associated with anxiety which in the long run can cause an abandonment of the learning subject. The examples for this can be found in our own experiences. Everyone knows at least one person, who as a child studied a certain skill and

later when gaining independence gave up or stopped practicing it. In order for a person to have pleasant, long-lasting and efficient educational experience it is important to evoke intrinsic motivation, and to say it in other words to deepen the interest of the student in a certain subject. To look at this in the perspective of a school book, on one hand, interest can be deepened by creating exciting, aesthetic book layouts with interactive elements, and on other hand if the book actually succeeds in aiding the memorization process, students will gain self confidence and competence of the subject fast, resulting in intrinsic motivation. Again the theory suggested by Alert Bandura, falls closely in line with R. Pekrun's definitions from his work 'Emotions and Learning'. If the design of the book can enhance positive emotions, this will directly have effects that will lead to Intrinsic motivation, ensuring long lasting, pleasurable and interesting learning experiences for the students.

2.5 Conclusion - Memory

The aim of this section was to define and explain the theories and approaches widely used by researchers and the leading authors in this field. In order to define how to improve and ease the learning process, one should be familiar with how the human brain works and how memorisation happens. Based on aforementioned analysis, one can deduct that there is much more to the memory than it looks from the first sight. The workload, design, senses and emotions all play a big part in the learning process and memorisation. Ensuring to focus on such aspects in the design will help to successfully define the framework and the external factors that can trigger students' motivation, interest, and most importantly easier memorisation for learning new content. An interesting question that appears from here is if there are specific memorisation techniques already in place that can support the cause? Modern literature widely mentions, roughly to say, technical aspects of memorization, but there is a plethora of information on what techniques were used in the past, by famous orators from the ancient Roman Empire. Next section will look into ancient memorisation techniques and try to find connections between current theories and ancient methods.

3. Mnemonic Techniques

As discussed in the previous chapter, the techniques of memorization, or so-called mnemonic techniques, were practiced in the Roman Empire as a part of rhetoric teachings. These techniques helped the orators to improve their memory enabling them to deliver lengthy speeches without any flaws. The teachings were important also in the European tradition and were never forgotten, up until relatively modern times. This section will look into three major earliest sources that are widely known by the experts and in this field: Cicero's "De Oratore", Ad C. Herennium Libri IV, and Quintilian's Institutio Oratoria.

3.1 Cicero's De Oratore: "Story of Simonides"

Marcus Tullius Cicero was a Roman statesman, lawyer and a scholar. He is remembered in modern times as the greatest Roman orator and the innovator of what became known as Ciceronian rhetoric (Balsdon, 2021). The first accounts of the art of memories are mentioned in Cicero's De Oratore -*"Story of Simonides"*. According to the story, there was a banquet hosted by a nobleman of Thessaly named Scopias, where Simonides of Ceos, a renowned poet, was asked to read a poem for the guests. At some point it is said that Simonides left the main hall, where the unfortunate accident happened and the roof fell down, killing and tormenting the bodies of the guests. The bodies were so damaged that it was impossible to distinguish their identities. As the story tells us Simonides remembered the sitting positions of all the guests who were sitting at the round table therefore he was able to recognize the identities of the bodies with his memory. After this accident, Simonides came up with the concept of the art of memory and called himself the inventor. He realized that organization and sitting order played a huge role in his ability for memorisation (Yates 1966). In the example of Simonides, Cicero introduces a technique, where a person must select a familiar place and build this place in his or her mind with the help of imagination. This person should form mental images of all the things that he or she desires to remember and store these images in certain locations in this imagined familiar place. When doing so the order of the places will preserve the order of the things, and the images of the things will denote the things themselves. The person should employ the places and images respectively as a *"wax writing-tablet and the letters written on it"* (Yates 1966). This approach is interesting in a

sense that, such organization of the memorisation objects, can stay in the memory even if they are nor related or distinct from each other.

Besides the importance of the arrangement and organization, Cicero also talks about the importance of sight as a sense of mnemonic technique. *"It has been sagaciously discerned by Simonides or else discovered by some other person, that the most complete pictures are formed in our mind of the things that have been conveyed to them and imprinted on them by the senses, but that the keenest of all our senses is the sense of sight, and the consequent perceptions received by the ears or by the reflection can be most easily retained if they are also conveyed to our minds by the meditation of the eyes"* (Yates 1966). As cicero implies, one of the most important factors in Simonides' discoveries is the discovery of the primal sense, which is the sense of sight that appeals to our minds and helps us to remember. He also mentions that all the senses are better retained if they are mediated by it. This is why most of the mnemonic techniques are based on the ability of imagination (Yates 1966). As a conclusion from Cicero's work one can deduct that visualization is the strongest tool and greatest addition to the study material. The order of the things can be connected with the idea of schema mentioned previously, where the element in schema has a specific order in which they are connected. The better the structure of the schema or otherwise said the better the order of things, more efficient will the retention be. Therefore having strong and vivid visual structure or layout of the content in the book can help the students to create better constructed schemas and therefore to have a better recall of the memory. It is important to underline that by saying that the structure and layout should be vivid, it is meant that the student should understand how to follow the content of the book, and in what steps or patterns he or she should go through the material. This does not imply that students should think how to learn and what steps to follow, but rather the structure of the design itself should define it by its vividness and readability. The structure of the visual side should help students to easily recall the information.

3.2 Ad C. Herennium Libri IV

Ad C. Herennium was a teacher who is known only from his writings of mnemonic teachings. In his work Herennium introduces quite specific methods of imagination. He starts dividing memory into two parts calling one a natural memory and the second artificial memory. Natural memories are born with thoughts and exist inside of humans, whereas the artificial memory is the one that can be trained and strengthened. The idea that he conveys is that training of artificial memory can also improve natural memory and mnemonic techniques (Yates, 1966).

The Loci is a Roman word that describes *"A particular position or place where something occurs or is situated"* (Oxford Dictionary, n.d.). In "*The Art of Memory"* the word loci is used as a place that is easily grasped by the memory. If one is willing to remember something then a place such as a house, a corner, or an arch should be chosen. Differently from the place images are as if like notes or simulacra of what we want to remember. If we want to remember the lion, an eagle, or anything, we must place the images in loci. As mentioned earlier, using loci (architecture) is essential for memorization, since it has a ready-made order, which makes it easier to memorize. The structure and organization of the loci also allowed the orators in ancient Rome to start from any point of the building and go through all the located images, which helped them to deliver the speech with no flaw. The images in our memory may disappear if we don't visit them often, but differently from them loci will never fade from the memory and it can be used as many times as one wishes. As Ad Herennium states loci should be a clear space without any people around so that there is no distraction. The chosen place should also be well defined and should not resemble a structure, such as intercolumnar spaces. Space should be of moderate size. They should not be too large since they can easily blur the vision and on the contrary, they should not be too small, as the images placed in them can get overcrowded. Similarly to the space lighting should be also moderate, not too bright, nor too dark, so that vision doesn't get disrupted. Additionally, distance is also something that should be taken into account (Yates 1966). The suggested architecture from this section, is quite similar to what was mentioned by John Sweller about the extraneous cognitive load. Similarly, Ad C. Herennium suggests that any kind of an external distraction should be removed so that the content is clear and so that the student can only focus on relevant information. It is

interesting to see how these ancient methodologies and theories are interconnected with the moderately recent researches and works.

3.3 Rules for Choosing Images for Words and Things

The memory for words and the things represent different parts of the speech. Memory for things is a subject matter of the speech, whereas "words" are the language in which the subject matter is clothed. The memory for words is so troublesome, that even Cicero agreed that memory for things should be enough for the student to perform well. In Ad C. Herennium's writings, there is a clear distinction between the images which should be chosen for remembering purposes. He states that our mind never remembers images that are too banal and every day like because there is nothing epic or marvelous in mundane things. On the contrary, things that are unbelievable, ridiculous and dishonorable, would most likely stick in the head for a long time. The sunrise never sticks to mind since it is an everyday occurrence, but if we look at the solar eclipse that happens rarely, there is a low possibility for the person to forget it. So Ad C.

Herennium advises to follow the nature of the memory and create images in mind that are spectacularly beautiful or ugly, and active rather than passive (Yates 1966). It is interesting to think of how the specific rules of memory placement can be translated. In his work Ad C. Herennium provides an example of a court case, where the prosecutor blamed the defendant in the murder by poisoning. Prosecutor announced the inheritance to be the motive for the murder and added that there were many witnesses to this crime. After introducing the reader to the story, Ad C. Herennium provides its alternative, which also serves as an example of a mnemonic visualization method through the following paragraph: *"We shall imagine the man in question as lying ill in bed if we know him personally. if we do not know him, we shall yet take someone to be our invalid, but not a man of the lowest class, so that he may come to mind at once. and we shall place the defendant at the bedside, holding in his right hand a cup, in his left, tablets, and on the fourth finger, a ram's testicles. In this way, we can have in memory the man who was poisoned, the witnesses, and the inheritance"*(Yates 1966). The symbols as images represent the subject matter of the speech, the cup represents poisoning, the tablets

represent the will or the inheritance, and the testicles of ram through the verbal similarity of the word testes symbolize the witnesses. This is a perfect example of the active, dramatic, and impersonated images that would stick to the mind for a long time. Compared to the memory of things, the memory for words was much harder to implement. The best and most effective way to memorize the words was to find similarities in their sounds, which later could be remembered by the association of one word to another. When it came to the memory of the poetry, which included systematic memorization of the words the author suggested using the mnemonic "cues". Cues might have been created from the associated images that were personal for each student and later placed in the memory palace. The rules on how to create images for loci, can be connected with germane cognitive load. In the example it is stated that when someone remembers something they should imagine the person who they know well, which in cognitive process translates as connecting old schemas to newly acquired information. Other than that when a student is asked to convert the information in some kind of scenery which has emotional attributes to it, increasing the cognitive load leads to deeper understanding of the content and to the encoding of that information in the long term memory. From the point of implementing these approaches in the design of the book, there are two ways the layout can be created. One is to use specific images, which depict emotions and the mood, since it will be different from everyday and usual pictures that are currently included in the majority of the school books. The second way would be to use visual communication in terms of typography, to try to visualize the work within it, or to use a different decorative typography, which again will serve a specific aim to give out sense of something new, make the students focus on the text and evoke associations from their own experiences.

3.4 Quintilian's Institutio Oratoria

Marcus Fabius Quintilianus or shortly Quintilian was a Latin teacher who has made major contributions to educational theory and literary criticism through his work on rhetoric, "Institutio Oratoria" (Clarke, 2022). In his writings Quitilian agrees with his predecessors and says that mnemonic techniques work on certain aspects of memorizing such as memorization for things. But different from others he stated that, when an orator was required to memorize poetry, then the memory palace would be a waste of time. In order to suggest an alternative

solution, he introduced another method, which in a way used mnemonic techniques to memorize. This technique can be considered to be the closest to the aim of this paper since it suggests creating the mnemonic system on paper or tablet which will ease the memorization process within less time. *"Namely to learn a passage by heart from the same tablets on which he has committed it to writing. For he will have certain tracks to guide him in pursuit of memory, and the mind's eye will be fixed not merely on the pages on which the words were written, but on individual lines, and at times he will speak as though he were reading aloud … This device bears some resemblance to the mnemonic system which I mentioned above, but, if my experience is worth anything, is at once more expeditious and more effective"* (Yates, 1966). From what Quintilianus implies, it is also possible and may be more effective, to create a mnemonic technique, not inside the mind, which would require undeniably well-trained memory, but to use the page or the tablet which will already have the system drawn or inscribed on it. That way a person could memorize a ready-made mnemonic system that would be less time consuming and could be used by people with average memory.

3.5 Rhythm and Rhyme as a Mnemonic Device

This section will examine the role of poetry in ancient nonliterate societies. Looking at this an interesting question to ask is how were the philosophies, stories, and moral statements preserved without writing? The answer to this is undeniably the living memories of people who orally transmitted the stories from one generation to another. Thinking about the philosophies of the statements, it would be impossible to preserve the original content of the speech through prose. There is a big chance that the content would deform and deviate from the original meaning over time since the only mediator is the orality and since there is no physical record of the actual, or to say more accurately the initial content. Technically the best way to preserve the content would be using poetry. A British scholar, Eric A. Havelock suggests the following in his work "*Preface to Plato"*: *"The only possible verbal technology available to guarantee the preservation and fixity of transmission was that of the rhythmic word organized cunningly in verbal and metrical patterns which were unique enough to retain thor shape"* (Havelock, 1963). Poetry depicts a story or any sort of content using rhymes and rhythm, which serve as a perfect and easy way for content memorization. Hence, by its nature,

poetry was frequently used for the establishment of moral standards, political ideologies, and warfares. Aside from the rhythm the appeal of the poetry also inquired in its nature the exaggeration and beautiful epicness, which worked as a sort of a hook of poetry, as it was taken closer to the listener's hearts and encouraged the memorization process deeply on an emotional level, which can also be considered as quite a strong technique (Havelock, 1963).

It is of the utmost importance to emphasize the mnemonic characteristics of the poetry itself. As discussed, rhythm and rhyme were some of the key techniques used to make any kind of content more memorizable. Exactly poetry, or to say it in other words, these memorization techniques that were based on pleasant sounding and rhythmic extravaganza, helped the cultures to be firmly preserved. In terms of history it is harder to implement rhythmic mnemonic systems, since the content of the history book is not written in a rhythmic manner, however it is interesting to consider and think how visuals can hint to a student that specific word or a sentence can be learned by using rhyme. This specific mnemonic technique might not be used in the project, but it will still be kept in mind during the process in case the content allows or needs rhythmic mnemonics.

3.6 Conclusion - Mnemonic Techniques

It can be seen that the theories used in ancient Rome for better memorisation, have much in common with the current approaches and learnings. Thus specific rules given by ancient Romans can serve as the framework in which design will be made. It is important to underline that most of the mnemonic techniques are based on the imagination, since it was an easily accessible and effective means. Considering the fact that these techniques are useful when using them by heart, but implementing them in the actual textbook can be trickier. Since mnemonic techniques share many similarities with the topics discussed in the section 2 of this paper, in the later phase it will be examined if the text can actually affect the cognition and improve the memorisation process. The next section will dive into different research papers, related to how typography and what kind of typography can serve as a tool to implement mnemonic techniques into the book through triggering attention to the content.

4. Typography Effects on Cognition and Memory

As per aforementioned sections, it is evident that there is much more to the memorisation process, than it can be seen from the first site. It is interesting to define how the theories introduced in different time frames shape and interconnect with ideas provided by different authors and researchers. There are numerous external factors that can help to shape and influence the learning process for the students, but when talking about the history school book, it is of the utmost importance to analyze the typography that should be used and its effects on the student's cognition and memory. As a next step, this paper will look into different typefaces that are widely used and will give a brief analysis on how these typefaces can affect cognition and how they can give a general outlook on researches that have been conducted in this field. Together with this numerous experiments and studies will be discussed, which were conducted in different countries and with different age categories to further explain and stress the importance of this topic.

4.1 Sans Forgetica

In the year of 2018 typographer Stephen Bahman with his team from Royal Melbourne Institute of Technology's (RMIT's) behavioral Business lab, created a typeface called Sans Forgetica (RMIT University, 2018). The font is based on the principles of cognitive psychology that enhance students' memorization process. This typeface is deliberately made "hard to read". The reasoning behind this design is to create the effect of the desired difficulty. Creators of the typeface state that desired difficulty experienced while reading, encourages the brain to engage in deeper processing which results in better long-term memory (RMIT University, 2018). The effect of the desired difficulty of the font is created with the line breaks inside the type design. The gaps are shaped fully with the brains' ability of closure, enabling learners to read the letters normally. Design meets the expectations, the typeface is well constructed and visually meets the idea of "hard to read font".

The researchers in Australia claimed they had designed a new font that helped the readers to boost their memory by making the information in the font feel more difficult to read, thus helping the readers to remember better. It is really interesting to look deeper into the details of Sans Forgetica and ask if it can really enhance and improve the memorization process. Researchers from the University of Warwick and the University of Waikato, New Zealand, have conducted numerous experiments to check whether the font 'Sans Forgetica' really enhances memory for information. The original team experimented on 400 students from where the results showed that 57% of the well-remembered facts were written in Sans Forgetica, and 50% were written in Arial. Besides these numbers, the researchers pushed this experiment further and conducted four more experiments with 882 participants, and published their findings in the paper "Disfluent difficulties are not desirable difficulties: the (lack of) effect of Sans Forgetica on memory" in the journal "Memory" (University of Warwick, 2020). In the first experiment they found out that Sans Forgetica feels harder to read compared to Arial, and also established the extent to which material written in Sans Forgetica feels more difficult to process. In the second experiment, the researchers aimed to compare people's memory for information displayed in Sans Forgetica and Arial. They showed pairs of words to the participants written in these two fonts and found out that people recall fewer pairs written in Sans Forgetica compared to Arial. The third experiment included the information from educational texts, and the results were analyzed in order to determine to what extent Sans Forgetica boosted people's memory, and according to the evidence from the results, Sans Forgetica has not improved the recalling process for the participants. For the fourth experiment, the researchers tested the participants on the understanding of the content where both fonts Sans Forgetica and Arial turned out to give an equal understanding of the text, proving that Sans Forgetica did not improve the understanding of the material. Considering all the findings from the experiments Andrea Taylor, from the University of Waikato, New Zealand mentioned: "Our findings suggest we should encourage students to rely on robust, theoretically-grounded techniques that really do enhance learning, rather than hard-to-read fonts" (University of Warwick, 2020). Even though the Sans Forgetica does not improve the memorization process the concept of the typeface is indeed intriguing. It is interesting why typeface fails its purpose and where it can be improved. The font is based on the idea of

“desired difficulty” introduced by Robert Bjork, which was based on the concern of students' attitudes towards the memorization process, as they thought that memory works like “Tape or Video recorder” (Durrington Research School, 2019). This sentence implies that many learners re-expose themselves to the same material over and over again believing that learning will be effective. The logic of the method is to focus the attention of a student on material that is hard to understand or read so that the brain forcefully starts a deeper thinking and analytical process. This method showed to be effective since it leads to a better understanding of the content (Durrington Research School, 2019).

It is agreeable that learning is something that needs a lot of processing and understanding of the material, so there should be an attention grabber inside the material that will create the spark for the process. ” The Desired difficulty” is an attention grabber that encourages deep processing, although it is interesting to think about the alternative and relatively easy ways to catch attention. The mnemonic methods were specifically created to make the memorization process easier. The insights, different memorization techniques, and logic, explained by ancient Roman scholars and teachers will enhance our understanding of the ancient mnemonic techniques that will open the secrets of memory mechanics and strategies. The ancient Romans were the ones who created the fundament for the mnemonic techniques, therefore it is of the utmost importance to know what their methods were and how they worked. Incorporating mnemonic strategies and methods in the learning hypothetically will make the process easier, enjoyable, and just as effective.

Even though sans forgetica didn’t show signs of improvement in memorisation process, there are other studies that provide solid proof that hard to read fonts can in reality enhance memorisation process. Two studies related to hard to read fonts will be discussed in the following section.

4.2 Hard to Read Fonts Are Better For Memory

Evidence shows that disfluency- *'metacognitive experience of difficulty associated with a cognitive task'* promotes deeper processing (Oppenheimer, 2010). Deeper processing as a result leads to better memory retention. The experiments conducted by M. Oppenheimer, Yauman and Vaughan, test if decreasing perceptual fluency of the content, can enhance memorization process and result in better recall. Two studies were conducted, for research: First one was in a controlled laboratory setting and second in the actual classroom (Oppenheimer, 2010).

4.2.1 Study 1

28 participants were recruited by Princeton University and their age varied from 18-33. The research was conducted in a highly controlled laboratory enviroment. Their task was to learn about 3 fictional aliens in 90 seconds. Each fictional character had seven features to learn, and in total participants had to learn 21 features. For disfluent content creation purposes 12pt Comic Sans MS 75% grayscale or 12pt Bodoni MT 75% grayscale fonts were used. Differently 16pt Arial 100% black font was used for the fluent content. Each participant was only exposed to one font. After 90 seconds have passed, attention drifted towards unrelated tasks for 15 minutes. After that recall test started. The questions regarding the alien features were asked. The result was statistically significant as participants with fluent condition recalled 72,8% whereas participants with disfluent condition recalled 86,5%. There were no differences shown regarding disfluent fonts (Bodoni and Comic Sans), which means that better recall is caused not because of the different font but their shared characteristic disfluency (Oppenheimer, 2010).

4.2.2 Study 2

For the second study 222 high school students aged from (15-18) from public school in Chesterland, were tested. Students from six different classes were examined: AP English, Honors English, Honors Physics, Regular Physics, Honors US History, and Honors Chemistry. The study materials were prepared in disfluencial or controlled manner and later distributed into different classes. For disfluency fonts like: Heattenschweiler, Monotype Corsiva or

Comic Sans Italicized were used. In controlled conditions nothing in the materials was changed. Font sizes were increased only in case of hard to read fonts, where legibility was too poor. Aside from the learning materials nothing else was changed. Two studies showed similar results as the first one, disfluent conditions improved the test scores of the participants, and there was no difference scoring within the disfluent font types (Oppenheimer, 2010).

4.2.3 Study (1&2) Analysis

Both studies have shown that hard to read fonts improve the memorization process, by being difficult to decipher. Because of that, the brain needs to focus more on the content and process deeper. The phenomenon of desired difficulty that hard to read fonts create increases intrinsic workload which in turn uses more germanic load and results in better learning. There are several downsides to using hard to read fonts actively, as the disrupted visual appearance of the text and its inefficiency to read easily can be overwhelming and demotivating for students when dealing with large chunks of text, similarly as in the history school books. On the other hand, hard to read fonts can be used as pointers to highlight important content, in that way it's going to serve as an attention grabber plus it will promote deeper processing of the specific content.

4.3 Hard to Read Fonts Can Cancel Out External Noises

The purpose of Nikalas Halin's study was to look closely into distractive external noises such as cars, loud speech or even aircrafts, that can be present during the text memorisation, and to see if hard to read fonts can shield students against disruptive effects of these sounds (Halin, 2016). In order to define whether this assumption was correct, 29 women with a mean age of 24,45 were chosen to participate in the experiment. They all reported to have good hearing, normal or corrected to normal vision and the experiment itself was conducted in their own language (Swedish). Prior to the experiment the recordings were made, which had different disruptive sounds like: mundane talk between a man and woman, sounds of aircraft passing by and traffic sounds. The texts that needed to be memorized were provided to the women, and the content of the texts was about different fictitious species. For hard to read condition the font Haettenschweiler was used, and for easy to read condition Times New Roman. The

paragraphs were displayed for 75s and automatically replaced by the next parapgraph after the time ran out. Later each person was asked to answer the questions regarding the material they just read. The results have shown significant difference in focus retention. The participants who had text written in hard to read fonts had better results on the test than people who had easy to read fonts (Halin, 2016).

This experiment only highlights the fact that hard to read fonts serve as good attention grabbers, because of their difficulty to be read. They can make the mind focus so much that it even can cancel out the most distracting noises. This example is very practical, since it can be helpful for the classroom environment. There are many distractions, especially for children in the eighth grade, hence helpful insight can be taken out from this experiment and applied to the design of the school book, to mimic the same results.

4.4 Memory and Metamemory (font size)

For effective learning, students need to have a specific learning cue that predicts a better memorization process. Since students do not have direct access to the memory traces, they deduce learning effectiveness from various cues such as "characteristics of the learning materials, the conditions of learning, or the subjective experience during learning" (Halamish, 2018). Judgments of learning are only predictive of learning when they rely on the believed learning cues. The cues of Judgment of Learning (JOL), which received recent attention include perceptual features of the written text. Two different types of textual materials can be discussed: a format that is readable and clear (adequate font size, type, and contrast) (e.g, 12p Black, Times New Roman on white background) and a second format that is hard to read (e.g, nine-point gray monotype Corsiva font on white background) (Halamish, 2018). Recent studies have shown that adults rely on their self-judgment "about memory, decision-making, and reasoning" on specific cues. Specifically, it is believed that clearer textual material is better remembered and learned, compared to hard to read the text. Hence, there is no definite answer if the predictive judgment helps to recall learned material. Such an effect was largely neglected with children. Preliminary studies examined the effect of perceptual features on children's recognition of text, whereas this research is focused on single word identification.

The question that is discussed in this study is, whether or not the font size would affect children's memory and metamemory judgments.

The principle of desirable difficulties and the principle based on research in cognitive psychology, suggest that challenging text can improve the long-term memory of the learner, thus improving learning outcomes. On the other hand, cognitive load theory suggests that for better processing it is necessary to avoid any reading distractions. The theory suggests that, if the brain has limited information to process, it will have enough resources to process the information effectively, resulting in better learning (Halamish, 2018).

Another research, more relevant to the current one, observed perceptual features of the single words or word pairs. "Following Rhodes and Castel (2008), a common manipulation involved varying the font size of the words, usually 48-point versus 18-point font" (Halamish, 2018). Up to the day, all the research has consistently proven that font size doesn't have any effect on memory and learning processes. It is deduced that the cue of using a larger type is a metamemory illusion. Recent meta-analysis over the studies discovered that there is a subtle advantage of larger fonts on memory. The effect is very small compared to the expectations of the participants. Some mnemonic benefits of larger fonts were accounted for in other research as well. The current research expands on the idea, by testing the effect of type size on memory and metamemory for words, with elementary school children.

For the experiment with elementary school children, 59 first and 46 fifth and sixth graders from a public school in Israel were chosen. Children were native Hebrew speakers and had no vision problems or learning disabilities. Before the test participants were tested on the real words and non-words reading rate and accuracy, to ensure they could read normally. The test consisted of "24 Hebrew words each, one for each age group, taken from norms. All words were two-syllables, 3–5 letter nouns with relatively high frequency (4 or 5 on a 1–5 scale, as rated by 10 elementary school teachers. Each list was randomly divided into two sets of 12 items each, which were also matched on familiarity and number of letters." Participants were asked to read aloud and study the words for later tests. The words were presented in various sizes from 48pt to 18pt. Words were presented once at a time for 8 seconds. Immediately after

the presentation participants were provided with JOL tests. Participants had exactly 8 seconds to answer the questionnaire. After that, they were asked to name as many list words as they could, while the experiment recorded their responses (Halamish, 2018).

Results revealed small but significant effects on font size (Halamish, 2018). Participants correctly recalled larger font words than the smaller ones. This result suggests that a larger font size enhances the memory of children. According to the results, the interaction of the age group and size was not significant. The result of JOL suggested that first graders were more confident in recalling words compared to fifth or sixth graders. Participants had higher JOL's for the larger sized text compared to the smaller text. The final result showed that similarly to adults', children also use font size as a cue for higher learning expectations (Halamish, 2018).

Bjork in their findings suggests that the larger font can improve children's memory, thus it is not consistent with the idea that difficulties are not always necessary. Moving on to the cognitive load theory (Sweller et al., 1998, 2011), using small font words might lead to a weaker memory for children as it implies irrelevant load that diminishes those processes that support better memory. It is important to mention that this theory was usually used for the learning material, which in comparison is more complex than the material of single words used in this study (Halamish, 2018).

Looking at the findings from Katzir et al., 2013 and the results from the current study, it is interesting to see how the effect of font size improved the memory of first and second graders in the current results and how it also improved reading comprehension in the findings from 2013. To look from a different point of view, these results show that children rely mainly on the letters that form the words, therefore larger fonts can be supportive of the more instructional learning materials. Compared to the first grades, looking at the results for the fifth and sixth graders, enlarged fonts similarly improved the memory according to the current study, but on the second hand weakened the comprehension according to the study from 2013. Looking at this it can be derived that not only the age has a significant difference when discussing the improvement of the memory and studies using large fonts, but also the material

and the goal of studies can be important to fully understand what effects fonts and text can have on children's ability to study and memorize (Halamish, 2018).

5. Interview

The interviews were conducted in order to gain insights from the learners about the design of their school books, and about their memorization hardships together with general suggestions. Participants were 3 female Georgian 8th graders who came from the same school and shared the same teachers in every subject. Their academic achievement varied from middle to high. The interview had simple seven questions. The format of the interviews was more fluent and deviated from the original questions to gain more insights. The answers for the question were merged for consistency and the main differences in the answers were provided. Some of the students had similar answers for specific questions therefore everything was aggregated.

5.1 Questions:

1.Is it easy for you to understand and memorize the text in the book?

All three participants said that memorization and understanding depends on the concrete subject. When they were asked which is the hardest subject for them to learn and why, they answered biology. One reason they collectively mentioned this was the teacher, who was described as short tempered and strict. The other reason was more related to the nature of biology itself. They reported that learning new unfamiliar words is very difficult, similarly to learning long and continuous text. One of the students also reported that her favorite subject is history and provided the explanation why. The reason was the teacher, who after each small paragraph had the processing sections, which in her words made it easier to understand the text. AS an addition using this approach is interesting and makes it easier for the students to learn.

2. When you look at your school book what catches your eye first?

Two of the students reported looking at the pictures first and one of them said that the first thing she looks at when seeing new study material is the table of contents. Students also generally reported that studying from the book was not their favorite experience, instead sitting in the classroom and listening to the information is more attractive for them.

3. Do you like how your school books look and do you think it can affect your studying process ?

Two of the participants answered that they liked the books' aesthetics, especially because of the beautiful images. They said that having interesting images inside the book got them more excited to actually read it. The other one said that she doesn't like how the books look and in general she doesn't enjoy reading them. She said that the school book looks bulky and boring.

4. Do you think there are unnecessary items or sections in the book that might be disruptive?

When the question was asked in this manner the students got confused and said they have never thought about something that might be an unnecessary detail in the book. During the interview when the conversation touched the point of distraction, one of the students mentioned that sometimes when the questions from the specific section is presented near the main content, she always looks at the questions in between the reading and loses the focus of where she was. She described this fact as quite distracting. In order to make this question more clear to them, I asked them to look at a specific page from the Georgian history book, and asked what was in their opinion the least important piece of information. When they looked at the pages they instantly got the idea of what I meant by the question and said that sometimes some images and text are unrelated or indirectly connected to the main topic making them an unnecessary element, but they also added that this problem doesn't bother them too much since they can skip the image easily.

5. Is there something that makes you lose focus on the text when reading and if yes what?

One of the students answered that the main source of distraction is the phone and the messaging sound, others also agreed on this. When asked about further distractions they said that nearly everything can be a distraction if the text is boring or too hard to understand. One of them also shared an experience of how distraction affects her learning. She mentioned that at some point she can drift away from the material even without her noticing it and when she does in fact notice she has to read the whole paragraph again. And the most frustrating fact she said is that it can at some point become a loop. It is important to mention that when girls talked about these experiences they mostly referred to the long and continuous texts.

6. Do you use any strategies for better memorization?

When asked about strategies, they all replied that when there is a need to study the content, like a word or a poem, by heart they just repeat it over and over again until it sticks to the mind. On the other hand one of the students said that for example in biology she looks at the question provided for the material and writes out exact answers from the text as bullet points and later studies only concrete sections. In short she is making the content more compressible and easy to learn.

7. Can you tell me any visual clues that might determine if the content will be easier or harder to learn?

All students agreed that content presented in very small text, with poor leading, and very small negative, alternatively means that the content will be hard to learn. If the content is put in larger font size, with well executed leading, and small portions, it would be easy to study.

5.2 Interview Analysis

Several factors can be deduced from the answers: 1) Several common problems for the students was the long and continuous text, that was boring to learn, and caused attention shifts. During learning they prefer the information to be given in small points or chunks. 2) The students have perceptual metacognition about the content presented in front of them,

saying relatively bigger fonts would be easier to learn. 3) Unnecessary instruction on the same page can cause distraction. 4) Memorizing words is the least favorite part of studying, since they mentioned the reason they dislike biology was because of the unfamiliar and wired words. 5) They prefer live classes, with lectures and teachers' explanations, rather than studying from the book. Most of the points taken from the interviews support previously mentioned topics about better memorizations.

6. Conclusion

In conclusion it can be stated that this vast amount of information can be used to create theoretically effective learning books, which will enhance the memorization process and help with the learning and memorisation process. It would be great if students could start to enjoy their school books and be less dependent on the teachers. At some point it can be said that this projects' attempt to create a book aside from the actual content can also teach students how to learn and develop. When concluding the paper it is important to talk about the practical project and possible implementations of researched information. First, and most important framework point, would be to get rid of any unnecessary and unrelated information, and by using white spaces create the focus on the content. All instructional information that is not helpful for the studying should be taken out of the page, and have their own specific sections. Second part of the framework would be the correct construction of the order and division on the page. In other words, bringing architecture to the page. As mentioned by one of the students, their teacher divides the content in small portions and chunks to make it more comprehensible. Similarly as discussed in the literature review the architecture of the book should include specific milestones, and its structure should consist of structured blocks, rather than of continuous and long texts. This in return will help the students to easily grasp new material in a structured way, and as a result will also assist the memorization process. The third part of the framework would be the creation of attention grabbers. The possibilities for this can vary, it can be done by random use of difficult to read fonts, or using visual communication in relation to words, together with appealing images or time speficic typefaces that can evoke emotions and association in students. In short all the design decisions should be justified by the content alone. There are specific problems that could arise when working with

this framework, giving content more space will automatically increase the number of pages which in return will increase the price of the book, plus it will be environmentally unfriendly. These factors can make the book inaccessible to a wide range of students, which can be a little problematic. That's why it's also important to have in mind that space costs money and there needs to be some compromises. The practical project will consider all of the factors mentioned above and use different tactics for each section of 8th graders history book.

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